



A new miniature species of the milliped genus *Cleidogona* from Costa Rica (Diplopoda, Chordeumatida, Cleidogonidae), with a review of Central American Cleidogonidae

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Abstract

Cleidogona huebnerae, n. sp., is described from La Gamba Tropical Research Station, Costa Rica. A total of sixteen species in three genera of Cleidogonidae are known from Central America (Guatemala south to Panama), and they are reviewed here.

Key words: New species, *Dybasia*, *Solaenogona*, Guatemala, Honduras, Costa Rica, El Salvador, Nicaragua, Panama

Introduction

The milliped family Cleidogonidae is the largest family in the Order Chordeumatida in number of species, and is probably basal to the order (Shear 1972, 2000; Hoffman 1999). Species of cleidogonids occur from the northeastern United States (Connecticut; Shear & Shelley 2004) south to peninsular Florida, and in the Mississippi River Valley from Illinois and Indiana to the Gulf Coast. With a brief hiatus in much of Texas, the distribution resumes in the Rio Grande Valley, extending into northeastern México, where many of the species are troglobionts, and thence south to Panama (Shear 1972), with the apparent southern limit near the former Canal Zone, though it is certainly possible that the family occurs in northern Columbia. Two of the included genera, *Cleidogona* Cook 1895 and *Pseudotremia* Cope 1869, each contain more than 50 species, and *Cleidogona* species occur throughout the entire North American range of the family except for Panama, where four species of the satellite genus *Dybasia* Loomis 1964 seemingly replace *Cleidogona*.

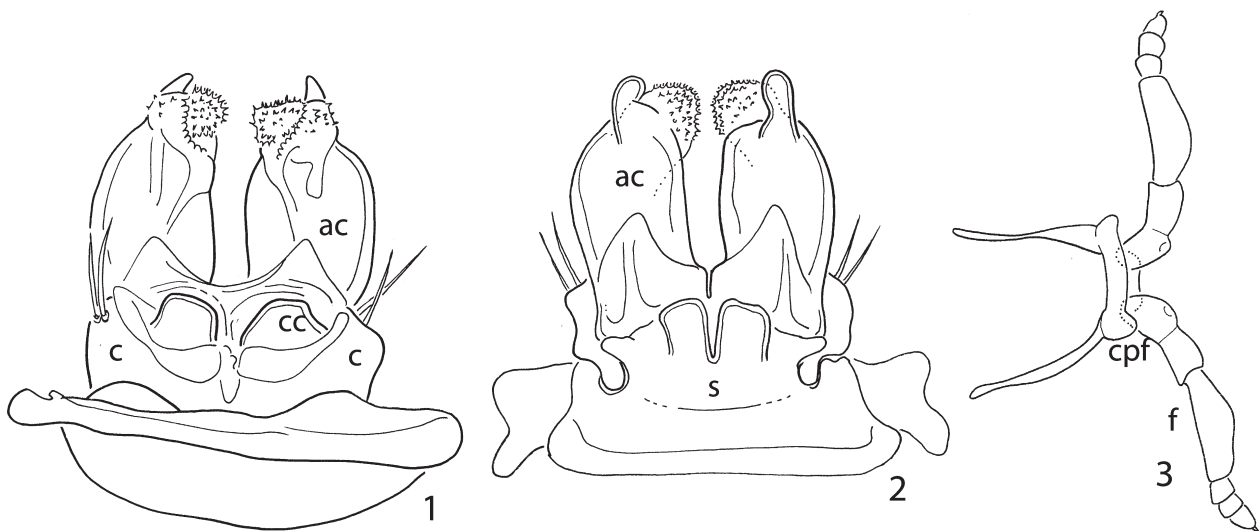
Troglobiotic Mexican species of *Cleidogona* rank among the largest of all chordeumatidans, at between 30–35 mm in length, but most species of the genus are around 15–25 mm long, with the smallest previously known being *Cleidoogona minutissima* (Kraus), at 11 mm long. Thus it was interesting to receive a collection of a new species of *Cleidogona* from Costa Rica that is a miniature, only about 7 mm long. This species is described below as *C. huebnerae*. Sixteen species of cleidogonids in three genera (*Cleidogona*, *Dybasia* and *Solaenogona* Hoffman 1950) have now been recorded from Central America, and I take this opportunity to review them and provide a key to the genera.

A new miniature *Cleidogona* species

Cleidogona huebnerae, n. sp.

Figs. 1–4

Types: Male holotype and two male and female paratypes, with other, juvenile specimens from Tropenstation La Gamba, Costa Rica, collected in 2008 by Barbara Hübner. Types deposited in Naturhistorisches Museum Wien, Austria.



FIGURES 1–3. *Cleidogona huebnerae*, n. sp., male. 1. Gonopods, posterior view. 2. Gonopods, anterior view. 3. Legpair 9, anterior view.

Diagnosis: Distinct from all other known Central American cleidogonid millipeds in the small size of mature specimens, being about 50% smaller than the next smallest congeneric species, and in the details of the gonopods (Figs. 1, 2)

Description: *Male:* Length, 7 mm, greatest width 0.62 mm. Ocelli 18, in five rows. Color light chestnut brown, dorsally mottled with darker purplish brown. Diplosegments with moderately developed lateral tubercles bearing lateralmost segmental setae; segmental setae about one-third width of body. Legpairs 1–7 only slightly more crassate than postgonopodal legs. Gonopods: in anterior view (Fig. 2) with broad sternum (s) not extending between angiocoxites, with paired, squarish median swellings; coxal knobs prominent. Coxae (c) with two setae. Angiocoxites (ac) short, broad, thin, with short, rounded apical process. In posterior view (Fig. 1) angiocoxite tips extend prominently posteriorly, with fine cuticular spinules. Colpocoxites (cc) very low, semirectangular, separated from angiocoxites by poorly sclerotized membrane. Ninth legpair (Fig. 3) reduced as usual for genus, but each with coxa, trochanter, prefemur (cpf) fused; coxal portion with small, perhaps vestigial gland openings surrounded by markedly thicker cuticle; femora (f) distally thickened. Legpairs 10, 11 typical, coxae elongate, with extruded glands. Legpair 12 with forward-projecting sternal peg fitting *in situ* between coxae 11.

Female: Length, 7.3 mm, greatest width 0.66 mm. Nonsexual characters as in male.

Distribution: Known only from the type locality.

Etymology: Named for the collector, Barbara Hübner.

Notes: One of the juvenile specimens collected with the types is a penultimate male, of interest because the ninth legpair, reduced in adult males, is of normal size in this instar. The gonopods appear as small primordia in place of the eighth legpair. While previously described Central American cleidogonids were primarily from higher elevations, this species comes from a lowland locality, suggesting that there may be additional species of *Cleidogona* to be discovered in such places.

The gonopods recall species of *Dybasia* (see below) in the short but obvious bifid sternal process and reduced colpocoxites, but are more complex at the angiocoxite tips. The ninth leg femora are distally enlarged, as in *Cleidogona*, and the coxoprefemora do not have processes. All in all, I think the species belongs in *Cleidogona*.

Tropenstation La Gamba is a field station in southern Costa Rica (8°42'03.67"N, 83°12'06.20W, elev. 75m) operated by Universität Wien and founded by Regenwald der Österreicher (Rainforest of the Austrians). Specimens of *C. huebnerae* were collected from leaf litter at two study sites, one a narrow ridge, and the other a steep slope down to a brook. Both were heavily vegetated with rainforest trees and understory plants but the canopy was less dense at the slope site. At both sites, the litter consisted mainly of fresh and undecomposed leaves, twigs, and fruits. The study focused on litter-trapping plants, but no specimens of *C. huebnerae* were taken in this microhabitat (B. Hübner, pers. comm. 2013).

Cleidogonid millipeds of Central America

The majority of chordeumatidan diversity is in the temperate zone of the northern hemisphere. In North America, a few species of Trichopetalidae and Conotylidae extend into northern and central México. Cleidogonids are the only chordeumatidan millipeds to be found in Central America, and one of only a few families in the order to occur in the tropics. South of the Panama Canal, tropical South America is devoid of chordeumatidans, which are found in that continent only in the temperate coastal regions of Chile (Family Eudigonidae, related to families in Australia and New Zealand; Shear 1988). In southeast Asia, the situation is different. The families Megalotylidae, Vieteumatidae, Metopidiotrichidae and Heterochordeumatidae are found from southern China to Sumatera, New Guinea and northeastern Australia, and at least the latter two are very species-rich; *Metopidiotrich* Attems is the third largest chordeumatidan genus in number of species, and many more remain to be named (Shear 2002). Metopidiotrichids also occur in subtropical and temperate Australia (Shear & Mesibov 1994). Madagascar, southern India and Sri Lanka have species of the chordeumatidan family Pygmaeosomatidae (Mauriès 1997).

Of the fifteen species listed below, most have been redescribed by me in my 1972 monograph. Based on the facts that 1) virtually every new collection seen from Central America consists of new species, 2) all of the known species come from single (or a few closely clustered) localities, and 3) up to three species can be collected at a single place, I confidently predict that the diversity of cleidogonids in that region will eventually rival the diversity of *Metopidiotrich* in southeast Asia (Shear 2002).

A key to the genera of Central American chordeumatidans is presented below. Unfortunately, because the types and only specimens of some inadequately described species cannot be located, and other species are known only from females, it is not possible at this time to make a key to species.

Key to genera

- 1a. Male ninth legpair coxoprefemora with distal projection, femora not swollen; gonopod colpocoxites small, simple; Costa Rica, Panama *Dybasia* Loomis.
- 1b. Male ninth legpair coxoprefemora without a distal projection, femora may be swollen, distally enlarged; gonopod colpocoxites usually more than half as long as angiocoxites, but may be smaller 2.
- 2a. Gonopods with massive posterior process from angiocoxites, ninth legpair femora cylindrical; Guatemala *Solaenogona* Hoffman.
- 2b. Gonopods without posterior process; femora of ninth legpair usually swollen, enlarged distally; throughout region. *Cleidogona* Cook.

Genus *Cleidogona* Cook

Cleidogona Cook, 1895, p. 3

I revised this genus in 1972 (see the revision for extensive generic synonymies) and just a few Mexican and North American species have been added since (see Hoffman 1999). *Cleidogona bifurca* Loomis, from Costa Rica, is the only Central American species to have been described since 1972 (Loomis 1974). Because some species are known only from females, others have not been illustrated, and holotypes have been lost, it is not possible to present a key to this genus in Central America. Those species known from males, and for which material was available for study, are illustrated in my 1972 monograph. The subsequently described species *C. bifurca* was illustrated by Loomis (1974).

Cleidogona austrina (Loomis)

Akakandra austrina Loomis, 1964, p. 99.
Cleidogona austrina: Shear, 1972, p. 158.

Type and only locality: Cerro Punta, Chiriqui Prov., Panama.

At the type locality, this species would be sympatric with two species of *Dybasia*, *D. chiriquia* and *D. divergens*, but Loomis' records of the latter two from Cerro Punta are based on females and juveniles and all three species are close in general appearance and size. Unfortunately the holotype is the only available male and the gonopods are not to be found in the vial (Shear 1972). The illustrations in the original description, especially of the ninth legpair, suggest that *C. austrina* might eventually find a better home in *Dybasia*. I did not place it there in 1972 because I was not able to study the gonopods, which Loomis depicted as very small, very simple, and lacking colpocoxites entirely.

***Cleidogona bifurca* Loomis**

Cleidogona bifurca Loomis, 1974, p. 184

Type and only locality: Cartago, Cartago Prov., Costa Rica.

It is hard to make sense of Loomis' description of this species and the single gonopod illustration is diagrammatic in the extreme, a lateral view from the evidently undissected holotype. He also refers to a bifid "lamina" in front of the twelfth legpair, evidently a structure additional to the usual forward-projecting sternal peg, which he describes separately. This would be a character unique in the family. See additional notes under *C. curvipes*.

***Cleidogona ceibana* Chamberlin**

Cleidogona ceibana Chamberlin, 1922, p. 11; Shear, 1972, p. 208.

Type and only locality: La Ceiba, Atlantida Prov., Honduras.

As I pointed out in 1972, the gonopods of this species, while conforming to the *Cleidogona* plan, are unique. In addition, as in the following species, the anteriorly directed process from the twelfth sternum is apically bifurcate.

***Cleidogona curvipes* (Loomis)**

Costaricia curvipes Loomis, 1966, p. 227.

Cleidogona curvipes: Shear, 1972, p. 158.

Type and only locality: Cairo, Limón Prov., Costa Rica.

Loomis (1966) based the genus *Costaricia* on the bifurcate process of the twelfth sternum, a character shared by *C. ceibana* and perhaps by *C. bifurca*, see notes above. I did not consider this single character to be diagnostic of a genus, but it may indicate relationship of the three species. The gonopods of all three appear to be distinct from each other.

***Cleidogona mandeli* Chamberlin**

Cleidogona mandeli Chamberlin, 1952, p. 13.

Type and only locality: Volcán Tajmulco, San Marcos Dep., Guatemala.

The holotype and only specimen could not be located by me in 1972 and subsequent inquiries in 2003 were also fruitless. Chamberlin's illustration of the gonopod in lateral view is highly diagrammatic and lacking in detail; about the only diagnostic feature that can be discerned is the relatively long, thin, sinuously curved colpocoxite.

***Cleidogona minutissima* (Kraus)**

Hirsutogona minutissima Kraus, 1954, p. 332.

Cleidogona minutissima: Shear, 1972, p. 222.

Type and only locality: Laguna de las Ranas, Sonosante Dept., El Salvador.

Kraus (1954) established the genus *Hirsutogona* with this species as type of the genus; also included were *C. mirabilis* (Kraus), *C. godmani* Pocock, and *C. stolli* Pocock. Kraus had mounted the gonopods permanently on microscope slides, with attendant crushing and distortion, which made them difficult to study in 1972. However, the species placed in *Hirsutogona* are perfectly typical of Central American *Cleidogona*. *Cleidogona minutissima*, despite its name, is still more than 50% larger than *C. huebnerae* n. sp.

***Cleidogona mirabilis* (Kraus)**

Hirsutogona mirabilis Kraus, 1954, p. 329.

Cleidogona mirabilis Shear, 1972, p. 221.

Type and only locality: Monte Cristo, Cerro de Metapán, Santa Ana Dept., El Salvador.

***Cleidogona punctifer* Chamberlin**

Cleidogona punctifer Chamberlin, 1943, p. 35; Shear, 1972, p. 158.

Type and only locality: Chichivac, near Tecpan, Chimaltenango Dept., Guatemala.

Described from a female and unillustrated, this species remains enigmatic. In 1972, the holotype could not be located.

***Cleidogona stolli* Pocock**

Cleidogona stolli Pocock, 1903, p. 52; Shear, 1972, p. 220.

Hirsutogona stolli, Kraus 1954, p. 329.

Type and only locality: Volcán de Agua, Sacatepequez Dept., Guatemala.

This species has small, short and simple gonopods suggestive of *Dybasia*, but the ninth legpair was missing from the type specimen and could not be studied.

***Cleidogona tajmulco* Chamberlin**

Cleidogona tajmulco Chamberlin, 1952, p. 15; Shear, 1972, p. 158.

Type and only locality: Volcán Tajmulco, San Marcos Dept., Guatemala.

As with *C. punctifer* (above), this species was described from a single female, which could not be found in 1972. In the same publication, Chamberlin (1952) described *C. mandeli* from a male collected at the same place and on the same day as the female holotype of *C. tajmulco*, but wrote that *C. tajmulco* was “a larger, more robust form than *mandeli*...(Chamberlin 1952)” and gave its length as about 3 mm longer than the latter species. There is ample precedent for syntopy in Mexican and Central American cleidogonids, but the size difference in the two specimens does not preclude their being male and female of the same species.

Genus *Dybasia* Loomis

Dybasia Loomis, 1964, p. 100

Loomis (1964) described three species of this Panamanian genus in three separate genera, which I synonymized under *Dybasia* in 1972. He also established a separate family Dybasiidae for these obvious cleidogonids. Loomis extended the range of the genus into Costa Rica when he described *Dybasia interamericana* in 1974. The species of *Dybasia* are small for cleidogonids, about 10–12 mm in length. The gonopods have long anterior sternal extensions which parallel the angiocoxites, and very small colpocoxites. The ninth legs have a long median extension from the coxoprefemur. The Panamanian species have prominent segmental paranota, but these were not described by Loomis (1974) for *D. interamericana*. Three of the four species are illustrated in my 1972 monograph, and *D. interamericana* by Loomis (1974). *Cleidogona austrina* (see above) may also belong in this genus.

Dybasia chiriquia (Loomis)

Solemia chiriquia Loomis, 1964, p. 105.

Dybasia chiriquia: Shear, 1972, p. 246.

Type locality: Finca Lerida, near Boquete, Chiriquí Prov., Panama.

Loomis (1964) also recorded specimens from Casita Alta and Cerro Punta, all near Boquete.

Dybasia divergens (Loomis)

Ogkomus divergens Loomis, 1964, p. 102.

Dybasia divergens Shear, 1972, p. 246.

Type and only locality: Almirante, Bocas del Toro Prov., Panama.

Dybasia humerosa Loomis

Dybasia humerosa Loomis, 1964, p. 101; Shear, 1972, p. 244.

Type locality: Finca Lerida, near Boquete, Chiriquí Prov., Panama.

Loomis (1964) also recorded this species from Cerro Punta near Boquete, but from females. However, the syntopic *D. chiriquia* is similar in size and general appearance, and Loomis did not study the female genitalia, so it is unclear how he distinguished the two species from only females.

Dybasia interamericana Loomis

Dybasia interamericana Loomis, 1974, p. 184.

Type and only locality: South side of Cerro de la Muerte along Interamerican Highway, San José Prov., Costa Rica.

Genus *Solaenogona* Hoffman

Solaenogona Hoffman, 1950, p. 91

Solaenogona has one species from Guatemala and another from nearby Chiapas, México (*S. chiapas* Shear 1972). The genus is distinct in the enormous processes which extend posteriorly from the angiocoxites, and the small, thin colpocoxites. The ninth legpair does not differ significantly from that found in some species of *Cleidogona* in which the femur is nearly cylindrical. Specimens are of moderate size, around 22 mm long. Although in 1972 I thought this genus was intermediate between *Cleidogona* and *Pseudotremia*, I now believe it to be just one of several specialized satellite genera around *Cleidogona*.

***Solaenogona guatemalana* Hoffman, 1950, p. 91; Shear, 1972, p. 194.**

Type and only locality: Between Santa Cruz del Quiché and Totonicapán, Chimaltenango Prov., Guatemala.

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Literature cited

- Chamberlin, R.V. (1922) The millipeds of Central America. *Proceedings of the United States National Museum*, 60, 1–75.
<http://dx.doi.org/10.5479/si.00963801.60-2403.1>
- Chamberlin, R.V. (1943) On Mexican millipeds. *Bulletin of the University of Utah, Biological Series*, 34, 1–103.
- Chamberlin, R.V. (1952) Further records and descriptions of American millipeds. *Great Basin Naturalist*, 12, 13–34.
- Cook, O.F. (1895) On recent diplopod names. *Brandtia*, 2, 5–8.
- Cope, E.D. (1869) Synopsis of the extinct Mammalia of the cave formations in the United States, with observations on some Myriapoda found in and near the same, and on some extinct mammals of the caves of Anguilla, W.I., and of other localities. *Proceedings of the American Philosophical Society*, 11, 171–192.
- Hoffman, R.L. (1950) Systematic notes on some Central American millipeds. *Proceedings of the Biological Society of Washington*, 63, 69–72.
- Hoffman, R.L. (1999) Checklist of the millipeds of North and Middle America. *Virginia Museum of Natural History Special Publication*, 8, 1–584.
- Kraus, O. (1954) Myriapoden aus El Salvador. *Senckenbergiana biologica*, 35, 293–349.
- Loomis, H.F. (1964) The millipeds of Panama (Diplopoda). *Fieldiana*, 47, 5–135.
- Loomis, H.F. (1966) Two new families and other North American Diplopoda of the order Chordeumida. *Proceedings of the Biological Society of Washington*, 79, 221–230.
- Loomis, H.F. (1974) Millipeds from southern Costa Rican highlands. *Florida Entomologist* 57, 169–187.
<http://dx.doi.org/10.2307/3493479>
- Mauriès, J.P. (1997) Matériel collecté par H. Franz, 1969 à Madagascar: nouvelles données taxinomiques et chorologiques sur le genre *Betscheuma* Mauriès, 1994 (Diplopoda: Craspedosomatida). *Annalen des Naturhistorischen Museums in Wien*, 99B, 539–554.
- Pocock, R.I. (1903) Chilopoda and Diplopoda. *Biologia Centrali Americana, Zoology*, 1903, 41–217.
- Shear, W.A. (1972) Studies in the milliped Order Chordeumida (Diplopoda): a revision of the family Cleidogonidae and a reclassification of the Order Chordeumida in the New World. *Bulletin of the Museum of Comparative Zoology*, 144, 151–352.
- Shear, W.A. (1988) The chordeumatid millipeds of Chile. *American Museum Novitates*, 2912, 1–10.
- Shear, W.A. (2000) On the milliped family Heterochordeumatidae, with comments on the higher classification of the Order Chordeumatida. *Invertebrate Taxonomy*, 14, 363–376.
<http://dx.doi.org/10.1071/IT99016>
- Shear, W.A. (2002) The milliped genus *Metopidiotrix* Attems (Diplopoda, Chordeumatida, Metopidiotrichidae). *Invertebrate Systematics*, 16, 849–892.
<http://dx.doi.org/10.1071/IS02005>
- Shear, W.A. & Mesibov, R. (1994) Australian chordeumatidan millipeds. I. New observations on the genus *Peterjohnsia* Mauriès, with the description of a new species from Tasmania. *Invertebrate Taxonomy*, 8, 535–544.
<http://dx.doi.org/10.1071/IT9940535>
- Shear, W.A. & Shelley, R.M. (2004) Introduction of the milliped *Cleidogona nantahala* Shear in New England, USA. *Entomological News*, 115, 71–77.